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The impact of microclimatic temperature on vector-borne disease transmission in Denmark

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Background

- Replication of arboviruses within the vector depends on the temperature surrounding the vectors – the microclimatic temperature
- The threshold temperature for Bluetongue virus (BTV) replication in *Culicoides* is approximately 15°C
- Most mathematical models for virus development in vectors use the standard meteorological temperature instead of the microclimatic temperature

Objectives

- To quantify the difference between the meteorological temperature and the microclimatic temperature
- To model the microclimatic temperature of different habitats using standard meteorological parameters as input variables
- To compare the impact of the microclimatic and meteorological temperature on vector-borne disease transmission

Methods

Site: Strødam, Denmark
Data Collection: May- October 2015



Fig.1a: Microclimatic temperature recorded by microchips- iButtons at four different habitats, Strødam



Fig.1b: Meteorological temperature recorded by weather stations, Strødam

Meteorological vs. Microclimatic temperature

- There were more microclimatic hours with temperatures >15°C compared to the meteorological stations both in cooler (May) and warmer months (August) (Fig.2 and Fig.3)
- Compared to meteorological temperature, microclimatic temperature showed a faster bluetongue virus development in *Culicoides* (Fig.4)

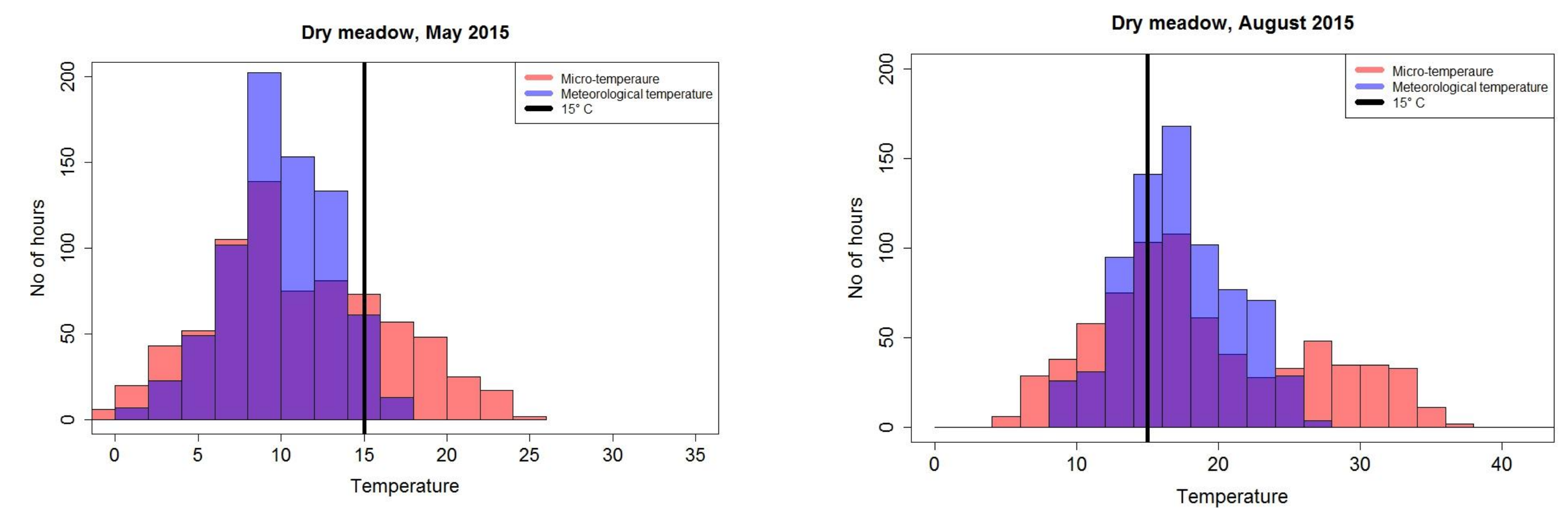


Fig. 2: In May, a higher no. of microclimatic hours had >15°C and in August, a higher no of microclimatic hours had >25 °C compared to meteorological temperature.

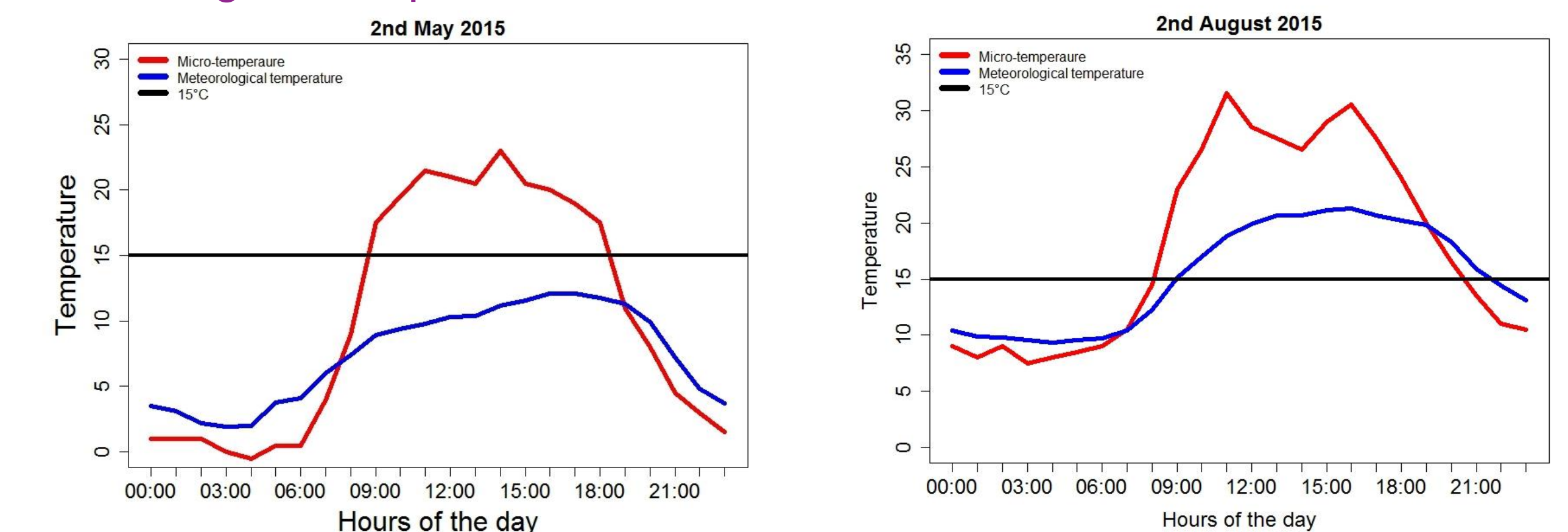


Fig. 3: Microclimatic temperature is higher at day and lower at night compared to meteorological temperature.

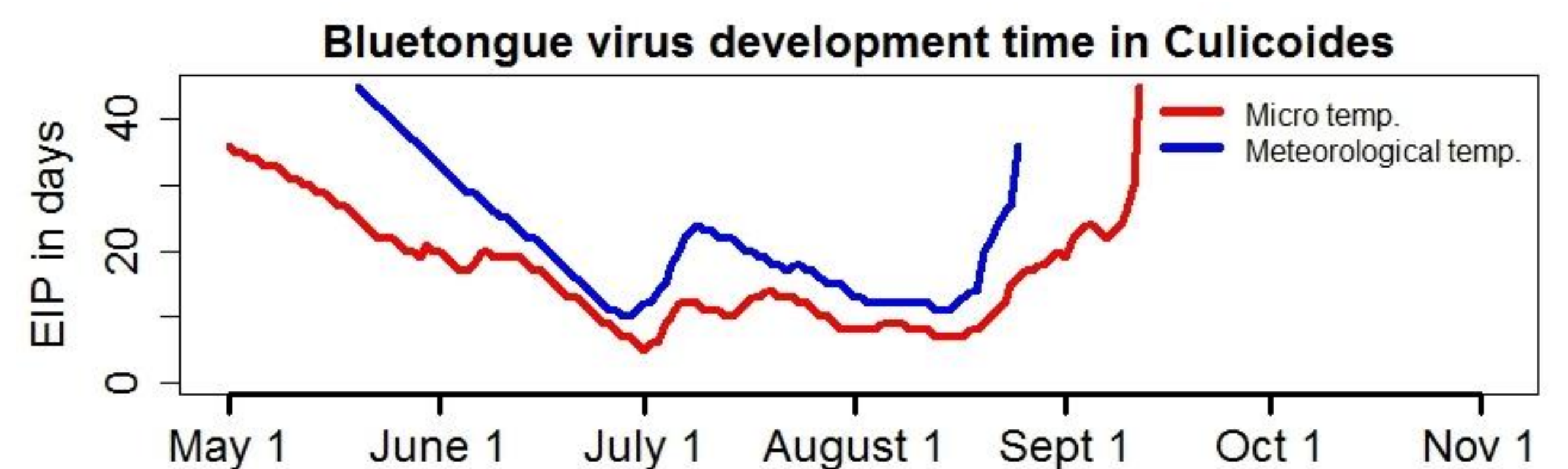


Fig. 4: Extrinsic Incubation Period (EIP) of Bluetongue virus (the time required for virus to become transmissible to another host after initial infection in a *Culicoides*): Virus development is more rapid in microclimatic temperature compared to meteorological temperature.

Modelling microclimatic temperature

- We were able to express microclimatic temperature of different habitats as a function of meteorological temperature, solar radiation, wind-speed, precipitation, humidity, months and time of the day in multiple linear regression analysis

Discussion

- There are large variations between meteorological and microclimatic temperature
- Microclimatic temperature fasten virus development compared to meteorological temperature
- Instead of measuring, we can model and thus predict the microclimatic temperature for whole Denmark
- Since vectors are short lived, a small differences in virus development time can greatly influences the vector borne diseases transmission

